

Cave dwelling cockroaches from Sarawak, with one new species

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ABSTRACT. The troglolithic cockroach, *Trogloblattella chapmani*, sp.n., is described. The genus was known previously from a single species found in limestone caves in Australia. Two of three other species found in the Sarawak caves, namely *Symploce cavernicola* (Shelford) and *Pycnoscelus striata* (Kirby) have previously been reported from cave habitats. The third, *Pycnoscelus indicus* (Fabricius), may have been reported previously from caves, under the name of *Pycnoscelus surinamensis* (Linnaeus). A single undetermined female of *Blattella* was present in the collection.

Introduction

This paper deals with a small number of species of cockroaches that were collected in caves by Mr Philip Chapman on the Royal Geographic Society Mulu (Sarawak) Expedition. The comments about the cave habitats and observations on the insects were supplied by Mr Chapman. With the exception of Niah Great Cave, all are in Gunong Mulu National Park, 4th Division, Sarawak. The specimens had been preserved in alcohol but were then mounted on pins and have been deposited in the British Museum (Natural History) (BMNH).

Trogloblattella chapmani sp.n.

(Blattellidae: Blattellinae) (Figs. 1-12)

Holotype ♂: Sarawak 4th Division, Gunong Mulu National Park, Wonder Cave (Gua Ajaib), 26.iii.1978 (*Philip Chapman*) (BMNH).

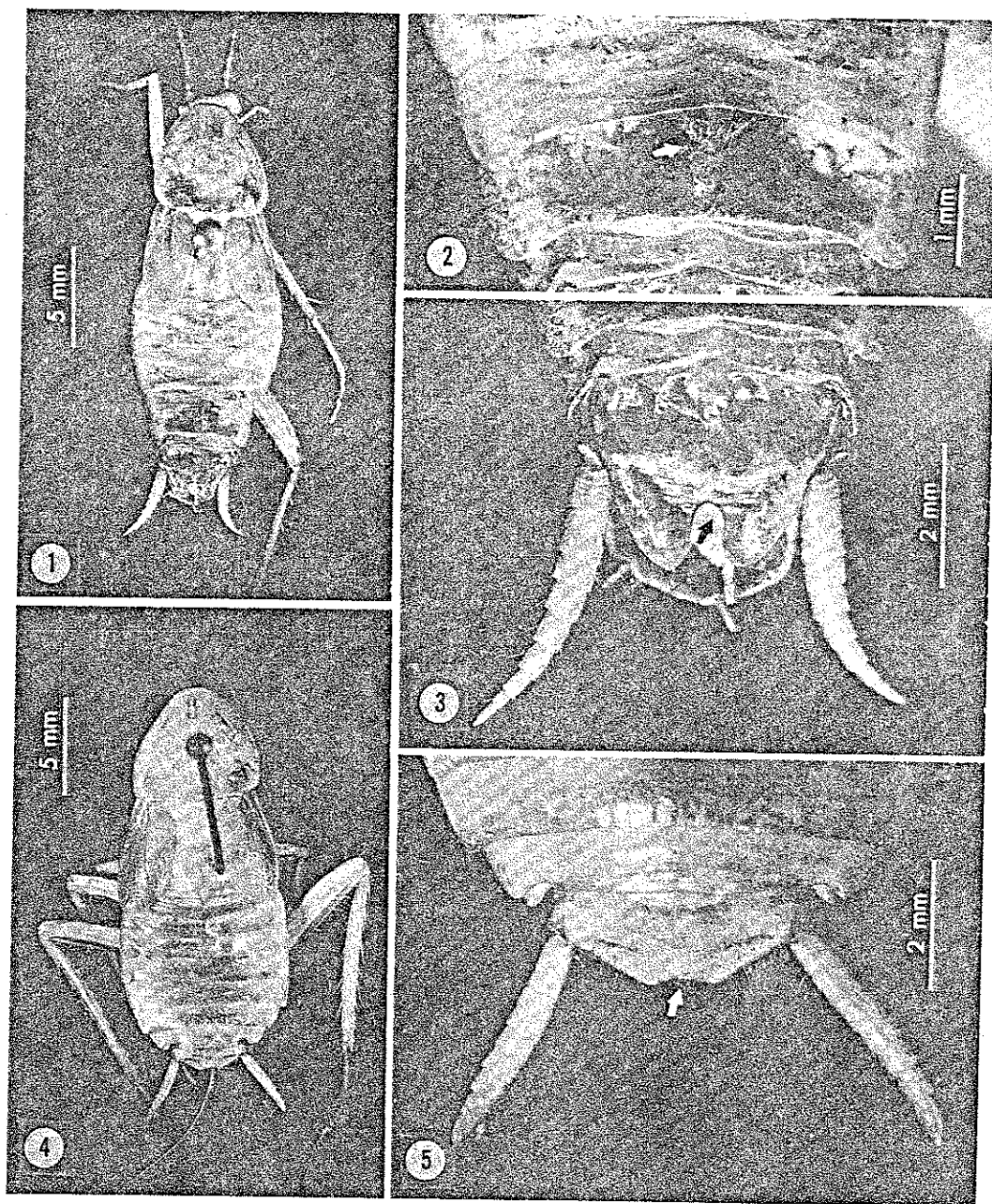
Male and female. Head partly or entirely concealed beneath pronotum, elongate, smooth with a few minute setae between the antennal sockets and longer widely spaced

setae on the clypeus and labrum. Eyes greatly reduced, represented by a small number of black ommatidia separated from contact with the antennal socket; ocelliform spots absent. Antennae much longer than the body. Maxillary palps long and slender, the third and fourth segments about equal and only slightly longer than the fifth.

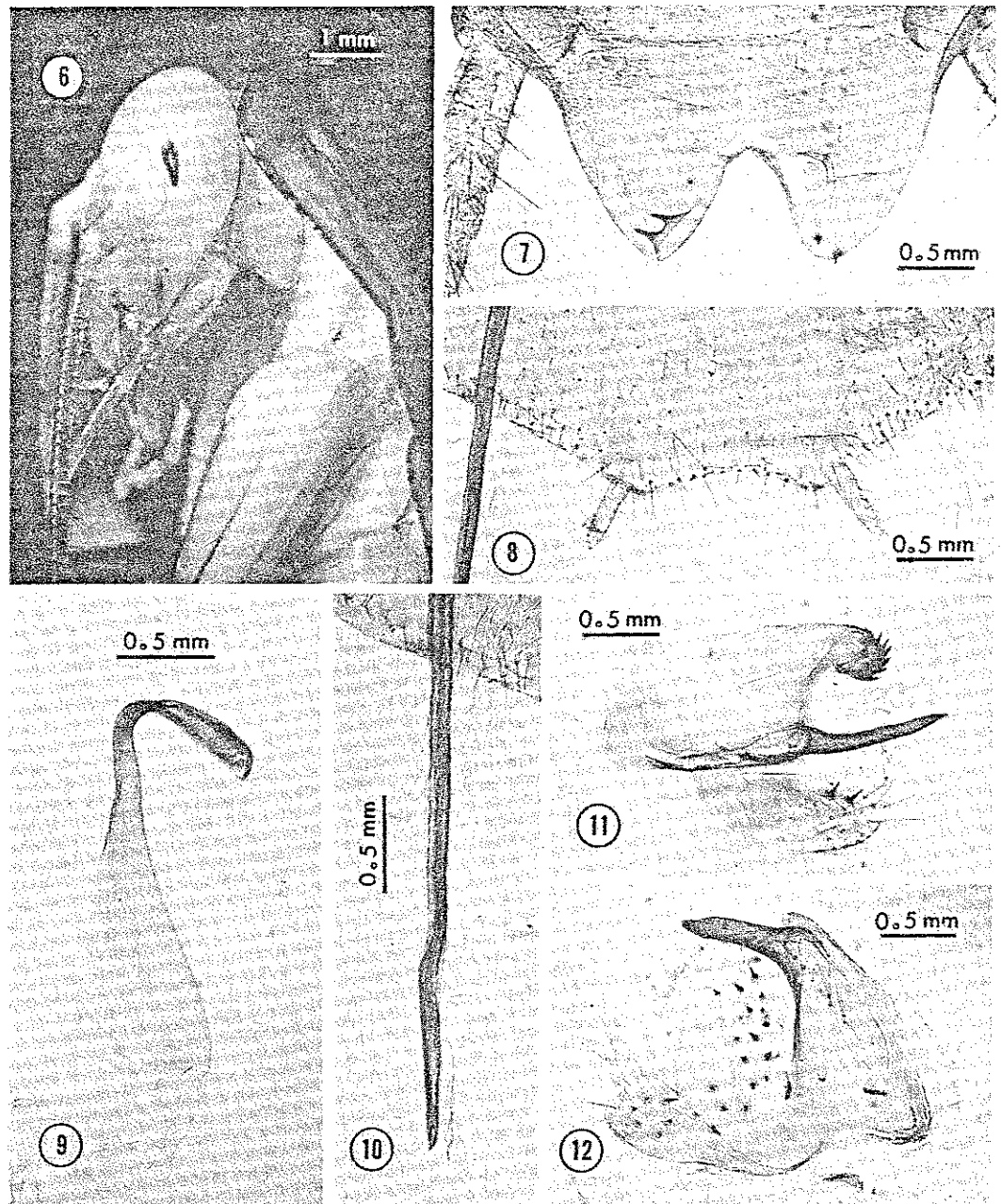
Pronotum convex, surface virtually smooth, long and narrow with rounded angles. Tegmina leaf-like, reduced lateral pads which extend just beyond the hind margin of the first abdominal tergite, venation subobsolete; wings much smaller, hidden under the tegmina, extending only to about the hind margin of the metanotum.

Legs very long and slender; anteroventral margin of front femur with 5 or 6 large spines on basal half followed by 10 or 11 smaller ones, and then by 2 or 3 longer terminal spines (includes the large distal spine), posteroventral margin with 4 or 5 well-spaced spines on distal half. Anteroventral margin of mid femur with 7 or 8 large well-spaced spines along the entire margin, posteroventral margin with 6 well-spaced spines. Anteroventral margin of hind femur with 6-9 well-spaced spines, and 5-7 on the posteroventral margin. Tarsi with some of the segments bearing short ventral spines; pulvilli and arolia absent.

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FIGS. 1-5. *Trogloblattella chapmani*. 1-3, Holotype ♂: 1, habitus; 2, abdominal tergites 6-9; arrow indicates tergal gland on segment 7; 3, abdominal tergites 8-10 and cerci; arrow indicates the medial excision in T10 (the styles on S9 are visible below T10). 4-5, Paratype ♀, Prediction Cave: 4, habitus; 5, abdominal tergites 6-10, and cerci; arrow indicates shallow concave hind margin of T10.



FIGS. 6–12. *Trogloblattella chapmani*, paratype ♂, Clearwater Cave: 6, head; 7, terminal portion of T10 (ventral view. Note small spines at tip of each lobe; the tip on left side bent in preparation of slide); 8, apex of S9 showing paired styles, and concave, setose, hind margin (rod-like structure on left is the virga); 9, left genital phallomere L3; 10, virga; 11, right paraproct so mounted that the spine is seen from above and the extent of its curvature is not indicated; 12, left paraproct. (Figs. 7–12 are from cleared, slide-mounted specimens.)

Abdominal tergite 1 (T1) of male unspecialized, T7 with a medial ridge bearing a small clump of short setae, a large deep non-setose depression on each side of the elevation. Abdominal tergite 10 of male deeply indented, the rounded corners of the indentation slightly bent ventrad with 2 short black spines on the ventral surface. T10 of female with short setae along the margins, the sides sloping to a shallowly concave hind margin. Abdominal sternite 9 (S9) of male almost symmetrical, its hind margin slightly concave, with a row of setae between the well-separated, setose, equal styles. S9 of female with scattered well-spaced setae, the hind margin rounded. Cerci long, many segmented. Right paraproct of T10 of the male is an enlarged, curved, acute, black spine that arises from the middle of a lightly sclerotized plate which has two lobes, one with short heavy spines, the other with long setae. The left paraproct is a much broader, slightly curved, obtuse spine, arising from a broad lightly sclerotized plate with small scattered setae. The left genital phallomere (L3) is hook shaped and greatly extensible. The virga (L2vm) is a slender, undifferentiated, sclerotized rod. General coloration brownish.

Measurements (mm) (male holotype; one female paratype, from Prediction Cave or Lubang Ramalan, in parentheses): Total length, 22 (21); pronotum length x width, 6 x 6.1 (6.2 x 6.6); tegmen length x width, 6 x 2.8 (6.2 x 3.1); width of abdomen, 7.9 (8.5); length of hind tibia, 10 (10.1).

The nymphs, which lack wings completely, differ from the adults as follows: in females, the hind margin of T10 is not concave, and those 19 mm or more lack styles. The males lack the gland on T7, T10 is not excavated, and the paraprocts are setose lobes without the large black spine. It is possible that young nymphs of both sexes have styles so that this structure cannot be used to determine the sex of the individual if the hidden genitalia are still undifferentiated. Minute eyes are present in the smallest (7 mm) nymphs.

Material (paratypes) examined and notes on cave habitats (the legs of many specimens were broken off, and the abdomens of a few individuals were also detached):

Snake Cave (Lubang Ular): 1♀, 7.iii.1978. The entrance is 200 yd north of Deer Cave in the Garden of Eden. The cave has an explored

length of 3500 ft. Halfway through the cave is a large muddy chamber where the single specimen of *chapmani* was taken.

Prediction Cave (Lubang Ramalan): 1♀, 2♂ and 1♀ nymphs, 3 nymphs (sex undetermined), 21.iv.1978. The entrance is below a large overhang in the south wall of Hidden Valley, a spectacular gorge cutting into the east flank of Gunong Api. The surveyed length of 2000 ft consists mainly of a passage about 300 ft wide and mostly 2 or 3 ft high. Near its end the cave opens up onto a great arête of fallen rock 80 ft high, skirted by a remarkable flat 'road' of firm damp silt. This is the home of a number of *chapmani*.

Wonder Cave (Gua Ajaib): 1♀, 2♀ nymphs, 4 nymphs (sex undetermined), 26.iii.1978. The tiny entrance is located 320 ft above, and almost northeast of, the camp site (main river sink) in Hidden Valley. Surveyed length is nearly 3 miles. Beyond the swiftlet-inhabited first chamber, a narrow, tortuous, muddy, flowstone-lined passage drops 300 ft before climbing to join the huge chambers beyond. Here (narrow passage) lives a flourishing population of *chapmani*. The great chambers are notable for their almost total lack of life. A variety of baits attracted a small number of troglobitic beetles (*Ptomaphagus*, sp.nov.) and nothing else. Close to the end of the known cave, two young nymphs of *chapmani* were seen on muddy cave coral in which they took refuge and could not be caught.

Clearwater Cave (Gua Air Jernik): 1♂ 1♀, 4 nymphs (sex undetermined), 23.iii.1978. Situated at the southern tip of Gunong Api is a prominent cave entrance right on the bank of the Sungei Melinau (Lubang Angin or Cave of the Winds). 200 yd upstream, the S. Melinau is joined by a large flow of clear green water which emerges from a boulder pile. The entrance to Clearwater Cave is 100 ft further up the hillside on the right, and behind it lies 16 miles of explored passages (15 miles surveyed). Several specimens were taken in ancient high level oxbows above the main river passage and one in a passage several miles underground.

Comments. *Trogloblattella chapmani* is confined to remote passages away from guano beds and the typical substrate is damp sticky clay or silt. Feeding was unobserved by Chapman but he suggested that it is probably an

opportunistic omnivore which subsists part-time on bacteria-rich clay (?). A troglobitic huntsman spider (? Sparassidae), whose range overlaps the cockroaches almost exactly, is probably predacious on it. The absence of tarsal pulvilli and arolia would indicate that it cannot climb smooth surfaces. The *Trogloblattella* were taken only in the dark zone of the caves, in absolute total darkness. They sometimes reacted to a caving lamp, presumably by running away, and sometimes they remained immobile. Chapman had the impression that they probably are sensitive to light and negatively phototactic. This species is a troglobite, i.e. one that is structurally modified and does not live outside of caves.

T. chapmani has all of the generic characters (Mackerras, 1967) of the genus. The habitus of this species is very similar to that of *Trogloblattella nullarborensis* Mackerras, until now the only known member of the genus, which inhabits the limestone caves in the Nullarbor Plain in South and Western Australia. *T. chapmani* is smaller and, from the few adults available, does not show the size differences between the sexes characteristic of *nullarborensis* (♂ 24–27.5 mm; ♀ 34.5–38.5 mm). The principal morphological differences between the two species are summarized in Table 1.

Symploce cavernicola (Shelford)

(Blattellidae: Blattellinae) (Fig. 13)

Deer Cave (Gua Payau): 22♂, 16♀, 2 nymphs, 7.iii.1978 (see cave description

under *Pycnoscelus indicus*). The southwesternmost guano bed is littered with slimy, guano-covered boulders heavily populated with *S. cavernicola*. In the central guano bed, *cavernicola* is mainly confined to the vicinity of occasional boulders. In the northeast guano bed it swarms in great numbers over the boulders. *S. cavernicola* was seen feeding on a partly decomposed bat, *Tadarida mops*, and on a dead member of its own kind. The nymphs may be predacious on the larvae of tineid moths with which they are associated, but this was not observed. Adults may eat young nymphs of their own species from time to time, but capture was not observed. Histerid beetles (*Hister* sp.) were observed feeding on young instars.

This species was originally described from specimens which were found in some numbers in a large and quiet dark cave in the limestone formation at Bidi, Sarawak (Shelford, 1907). It has also been reported from Sumatra and Malacca (Princis, 1969). I collected a dead male (identified by K. Princis) in a bat cave in Sara Buri Province, Thailand, on 29.iii.1967. *Symploce cavernicola* is probably a troglophile (habitual cave dweller) but is not structurally modified.

The specimens agree with Hebard's (1929) comments about the species. It is readily recognized by the pronotum which is cinnamon-rufous completely margined with black which may show a faint brown tinge. In the male the dorsal surface of the first abdominal tergite has a proximolateral deep triangular impression, but no setae. The seventh abdominal

TABLE 1. Differences between two species of *Trogloblattella*

Structure	<i>nullarborensis</i> *	<i>chapmani</i>
Eyes	Absent (Pl. 1, Fig. c)	Reduced (Fig. 6)
Gland on T7 (♂)	Large glandular area covered by setae (Fig. 1)	Setae restricted to a medial ridge, large depressed zones non-setose (Fig. 2)
T10 (Hind margin)		
♂	Nearly straight (Fig. 1)	Deeply invaginated (Figs. 3 and 7)
♀	Rounded (Fig. 3)	Shallowly concave (Fig. 5)
Paraprocts (♂)		
Right	Slender, pointed with one setose lobe (Fig. 4)	Long, hook-shaped, acute, with two lobes (Fig. 11)
Left	Broad, plate-like (Fig. 4)	Stout obtuse spine (Fig. 12)
S9 (♂)	Asymmetrical with two short subequal styles, right one occupying a medial position (Fig. 5)	Almost symmetrical, styles lateral, well separated, about equal in size (Fig. 8)

* Figures refer to those in Mackerras (1967).

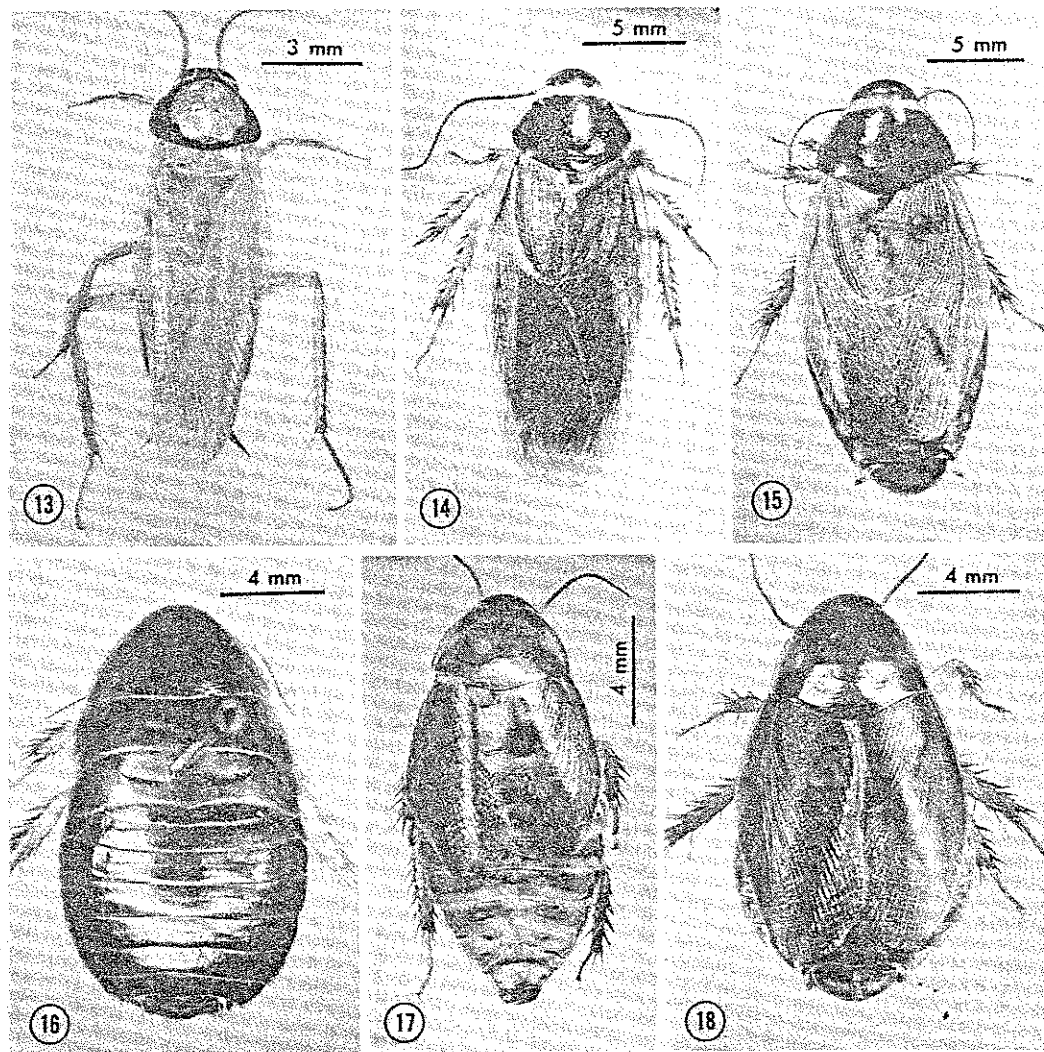
tergite has a medio-longitudinal ridge flanked by large impressed areas with minute scattered setae. The supra-anal plate is decidedly transverse and little produced between the cerci. The subgenital plate is a large asymmetrical lobe, bearing two cylindrical styles, the one on the right being slightly heavier with a few minute, short spines dorsad.

The abdomens of the two small nymphs were missing. The pronotum is uniformly dark, except in the larger nymph which has a pair of widely separated small pale dots. The meso- and metanotum have rather large pale, transparent areas, but are dark laterally.

Blattella sp.

(Blattellidae: Blattellinae)

Deer Water Cave (Lubang Sungei Payau): 1♀ 25.iv.1978. Following the river up the Deer Cave Valley leads to a pile of boulders under the northern flank cliffs. Immediately over these a wide arch leads back into the river, and the Deer Water Cave. After 2900 ft the simple conduit ends in a sump which the survey indicates is about 300 ft long to the sump pool in Deer Cave. Halfway along the cave is a large pile of guano-covered boulders below a nesting colony of cave swiftlets



FIGS. 13-18. Cave dwelling cockroaches from Sarawak: 13, *Symptloce cavernicola* ♂, Deer Cave; 14, 15, *Pycnoscelus surinamensis*, ♂ and ♀, Deer Cave; 16-18, *Pycnoscelus striata*, nymph, ♂ and ♀, Niah Great Cave.

(*Collocalia* sp.). The single specimen of *Blattella* was collected here.

The female specimen has pronotal markings similar to those of *Blattella germanica*. However, males are needed for specific determination since several other species of *Blattella* have similar markings.

Pycnoscelus indicus (Fabricius)

(Blaberidae: Pycnoscelinae) (Figs. 14 and 15)

Deer Cave (Gua Payau): 16♂, 6♀, 1 nymph, 8.iii.1978. This gigantic cave passes through a limestone ridge east of the Melinau Paku valley and carries drainage from the 'Garden of Eden', a spectacular blind valley on the side of Gunong Api's west ridge. It is reached by a well-used footpath from the Sungei Paku. Surveyed length of the cave is 5750 ft. A population of about 600,000 bats (*Tadarida mops*) occupies three main roosts, two in the southwestern half of the cave, and one near the northeast entrance. The central bed is largely smooth guano and is dominated by the burrowing *Pycnoscelus indicus*. The northeast guano bed is steep, with huge boulders interspersed with deep, steeply inclined guano deposits. *P. indicus* predominates in the deep 'guano drifts'. *Pycnoscelus indicus* was observed feeding on freshly killed and decomposing bats (*Tadarida mops*) and appears to be the main predator of the hairy earwig (*Arixenia esau*) on this guano heap. The nymphs may be predacious on the larvae of tineid moths with which they are often associated, but this was not observed. Adults may eat younger instars of their own kind from time to time (feeding observed, but not capture). Similarly, histerid beetles (*Hister* sp.) were observed eating parts of young instar cockroaches.

The nymphs are characterized by the smooth shiny thorax and first three abdominal segments, the remaining abdominal tergites being roughened, shagreenous and dull. The pronotum of the adults is characteristically dark with pale anterior and lateral margins.

Pycnoscelus indicus is the bisexual form of the parthenogenetic *Pycnoscelus surinamensis* (Linnaeus). They are sibling species and the females are difficult to separate morphologically. The evidence for considering them distinct species is mainly biological. *P. suri-*

namensis reproduces only parthenogenetically, normally producing only females; the rarely occurring males are non-functional. The fertility of *surinamensis* females is greatly reduced if they are mated to *indicus* males. *P. indicus* can reproduce only bisexually and produces males and females in a 1:1 ratio; their unfertilized eggs do not develop (Roth, 1967; Roth & Willis, 1961). The records of *P. surinamensis* taken in caves in the Indo-Malayan region (e.g. Chopard, 1924; Hanitsch, 1932) may well have been *indicus*, although no males were found among the few specimens reported. However, I have collected *P. surinamensis* in a cave in Thailand and it has also been taken in a cave in Jamaica (Roth, 1974). Both *P. surinamensis* and *P. indicus* are troglonexes (sporadic inhabitants of caves).

Pycnoscelus striata (Kirby)

(Blaberidae: Pycnoscelinae) (Figs. 16–18)

Niah Great Cave: 5♂, 6♀, 3 nymphs, 22.v.1978. This is the best known and largest cave in the Batu Niah National Park, some 90 km WSW of Mulu. It is a huge cavern with numerous entrances and vast populations of cave swiftlets and bats. The habitat of *striata* is almost exactly like that for *Pycnoscelus indicus* found in Deer Cave.

Kirby's (1903) specimens were taken near caves in Selangor, Malaysia. Chopard (1919, 1929) reported *striata* as abundant and burrowing in bats' guano 50–600 ft from a cave entrance, and also on the walls of an inner cavern. Hebard (1929) stated that the male rather than the female shows tegminal reduction but in the present series of specimens both sexes have variably reduced tegmina and wings, their tips not reaching the ends of the abdomens. The male of *striata* can be distinguished from the male of *indicus* by the terminal abdominal segments. In *striata*, the hind margin of the eighth abdominal sternite is truncate and the ninth is exposed and longitudinally divided; in *indicus* the eighth sternite is rounded posteriorly, the ninth is completely hidden, and not divided, and there is a single style. The male genitalia differ between the two species and are illustrated in Roth (1973).

The nymph of *striata* can be distinguished from those of *P. surinamensis* by its uniform shiny colour, the abdominal segments lacking

the minute elevations and dull shagreenous appearance of the latter. The pronotum of the adults is dark in the middle with reddish sides, but lacks the pale marginal markings of *surinamensis*. *Pycnoscelus striata* is probably a troglophile.

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